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Government Entomologist, Anglo-Egyptian Sudan.

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CLEAN CULTIVATION
IN ITS RELATION TO
THE CONTROL OF INSECT PESTS.

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Harold H. King, F. L. S. F. E. S.,
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The importance which the suppression of weeds, and clean and careful methods of farming generally, bear to the control of insect pests is usually underestimated, if indeed, it is realised at all. The term weed is usually applied to any plant which is neither useful nor ornamental, but from a farmer's point of view, any plant which is out of its proper place is equally a weed. For example, a dura plant growing in a field of cotton is a weed, and so is a selfsown melon plant growing on the bank of a water channel.

Insect pests may be divided roughly into three groups, viz :—

(a) Insects having a single hostplant.
(b) Insects having two or several hostplants.
(c) Insects which are practically omnivorous.

(a) Insects having but one hostplant are rare, and have usually been introduced from some other locality. Examples are the Sudan cotton bollworm (*Diparopsis castanea*), which in the central and northern provinces of the Sudan has never been found attacking any plant except cotton, and the dura asal fly (*Aphis sorghi*), which in Dongola Province is restricted to feeding on the varieties of dura. Both these insects are probably natives of Central Africa, where they may possess other hostplants.

(b) The majority of the insect pests of crops possess two or several hostplants. Usually, but not invariably, the hostplants of any one of them are closely related botanically. The Egyptian cotton bollworm (*Earias insulana*), and the cotton flea beetle (*Nisotra uniformis*), can feed on bamia (*Hibiscus esculentus*), karkade (*Hibiscus sabdariffa*), and hanbuk (*Abutilon spp.*), all of which are allied to cotton. The dura stemborer attacks maize and wheat, and the Blue Nile "andat" (*Agonoscelus puberula*), which sometimes causes a great deal of damage to dura, feeds also on wild grasses. The cotton aphis or asal fly has, however, as alternative hostplants, members of the melon family (*Cucurbitaceae*) which are in no way related to cotton.

(c) Insects which may be considered practically omnivorous are locusts, grasshoppers (gabura), crickets and cutworms. These pests, while possessing preferences for various plants, are capable of feeding on almost anything.

Few crops are on the ground throughout the year. Cotton should occupy the land for not more than ten months; dura, the staple crop of sakia land, is not usually grown as a winter crop, while barley, wheat, beans, bamia etc. rarely take more than four months from seed time to harvest.

When a crop is harvested, the insect pests which have been feeding on it are suddenly confronted with a shortage of food and under these circumstances various insects behave in various ways. Some pass into a resting stage and lie dormant, hidden away in the soil or in the remains of the crop. Others continue to feed on what is left of the crop, if it has not been destroyed, or migrate to other hostplants growing in the vicinity. In any case, the harvesting of a crop means the deaths from starvation of large numbers of insects, it being only the fortunate individuals which are either ready and able to find a safe place for concealment in which to lie dormant, or succeed in reaching a suitable hostplant on which to eke out a possibly more or less precarious existence until times of plenty come again.

If land which has been under cotton is ploughed and worked before the new cotton crop is sown, numbers of the Sudan cotton bollworm, which are in the pupal stage in the soil, will be crushed or exposed to the attacks of their natural enemies, such as birds.

If no cotton, bamia, karkade or hanbuk plants are available, the Egyptian cotton bollworm and the cotton flea beetle will have great difficulty in tiding over the period which elapses between the burning of the cotton sticks and the sowing of the next cotton crop. If all dura stalks and roots could be burnt as soon as the dura has been harvested, immense numbers of dura stemborers which are lying dormant within the stems, would be destroyed. If when the melon crop has been harvested, the melon plants and all rubbish on the land are collected into heaps and burnt, myriads of the black melon bug (*Aspongopus viduatus*) will be killed. These instances could be multiplied almost indefinitely, but the few given are sufficient to indicate the importance of clean methods of farming.

Recommendations:—The entire farm and uncultivated land immediately adjoining should, as far as possible, be kept free from weeds. Particular attention should be paid to canal and gadwal banks, waste land surrounding buildings and land under bare fallow. On the farm, plants should be rigidly restricted to the areas on which they have been sown—a selfsown melon plant growing on a canal bank may produce a few melons for the native charged with the duty of keeping the canal banks clean, but will also possibly harbour the cotton aphis, and so give rise to an outbreak of "asal" among the cotton. To the farmer, the stray plant of dura or cotton is as much a weed as usher (*Calotropis procera*) or hanbuk. The plants which appear on waste land, or land under bare fallow, are almost invariably inedible to stock and may rightly be looked upon as entirely useless. Such plants should be uprooted and burnt.

All diseased plants and fruits which are unlikely to yield, or to be of any value, should be destroyed. For example, a melon which is seen to be infested with the maggots of the melon fruitfly (*Dacus brevistylus*) should not be left on the ground but thrown into the river, where it will sink and the maggots be killed. If it is left in the field the maggots will leave the fruit to pupate in the soil, and later give rise to adult fruitflies, capable of destroying numbers of melons.

When a crop has been harvested the refuse of the crop which is not needed for forage or manure should be uprooted, collected into heaps and burnt, together with all other rubbish on the ground, with as little delay as possible. Under no circumstances should the sticks and stalks of cotton and dura be used for building shelters or windscreens. I have taken more than seventy dura stemborers from a windscreen only a few yards in length, constructed of dura stalks to protect a small area sown to vegetables. If material of this kind is needed for shelters, the Egyptian thornless seseban (*Sesabania aegyptica*) can be grown to provide it.

When dura or other gussab is fed to stock, the thicker parts of the stems, which cattle refuse to eat, should be collected each day and burnt.

Land which has been under a crop should, shortly after the crop is removed, be ploughed. Ploughing crushes numbers of insects which are in the soil, and exposes others to the attacks of their natural enemies.

It is not suggested that, if the above measures are carried out, an entire freedom from insect pests will be obtained. There is, however, no doubt but that clean and careful methods of cultivation result in a diminished number of those insects which reduce annually the yields obtained from the land.

Wellcome Tropical Research Laboratories,
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